Cancer Rates in the Proximity of SeaTac International Airport (Questions 1 and 2 of the August 1998 Work Plan)

Prepared by
Washington State Department of Health
Office of Epidemiology
February 25, 1999

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EXECUTIVE SUMMARY

This report is being issued in conjunction with several other documents as part of our investigation outlined in the work plan developed by SeaTac community representatives in cooperation with the Washington Department of Health and the Seattle-King County Department of Public Health in August 1998. Questions 1 and 2 from that work plan are the primary focus of this report:

1. What types of cancer are the most prevalent in the proximity of the airport, and what are their risk factors?
2. Are the rates of breast cancer elevated in the proximity of the airport?

The proximity of SeaTac International Airport was divided into three areas for analysis: Area 1 is equivalent to 1 mile around the airport; Area 2 is within 3 miles of the airport; Area 3 is within 5 miles of the airport. More than 25 categories of cancer for the period from 1992 through 1996 were analyzed to determine statistically significant differences between observed cases in the area of interest and expected cases based on two comparison groups, King County and Washington State as a whole.

Results of numerous analyses found that the ten most prevalent cancers around SeaTac Airport were consistent with the ten most prevalent cancers in both King County and Washington State. However, some cancers, depending upon the comparison group, were found to be higher than expected in one or more of the areas around SeaTac Airport, and other cancers were found to be less than expected.

In Area 1, endometrial and lung cancers were higher than expected when compared to both King County and Washington State; cancers of the oral cavity or pharynx were higher than expected only in comparison to Washington State. No cancers were statistically less than expected in Area 1.

In Area 2, glioblastoma was higher than expected when compared to both King County and Washington State; laryngeal cancer was higher than expected when compared to King County; liver cancer was higher than expected when compared to Washington State. Prostate cancer was lower than expected in Area 2 when compared to Washington State.

In Area 3, laryngeal cancer was higher than expected when compared to both King County and Washington State; kidney/renal cancer was higher than expected when compared to King County; liver cancer was elevated when compared to Washington State. Melanoma and prostate cancer were less than expected when compared to both King County and Washington State; all cancers, breast cancer and thyroid cancer were less than expected when compared to King County.

Although substantially more types of cancer than originally specified by the work plan were analyzed for this report, a few categories were of special interest to SeaTac-area residents. Brain cancers (particularly glioblastoma), breast cancer, and leukemia (particularly acute myeloid leukemia) were of specific interest. Of these, only glioblastoma was higher than expected for the period from 1992 through 1996, and this elevation was restricted to within 3-miles of the airport. Observed cases of breast cancer were consistently within expected range regardless of comparison group except that they were even less than expected for Area 3 when compared to King County. All types of leukemia, including acute myeloid leukemia, were consistently within the expected range.

Of the cancers for which observed cases were found to be higher than expected, review of the literature did not reveal any definitive causes of the increased numbers that can be specifically attributed to proximity to the airport. Despite an extensive review of the literature by the Seattle-King County Department of Health and the Washington State Department of Health, no proven risk factors for glioblastoma in people were identified.

Tobacco exposure is the best-established risk factor for cancers of the larynx, lung and oral/pharynx. Alcohol abuse, particularly in combination with tobacco use, tends to increase the risk of laryngeal, oral and pharyngeal cancers, and air pollution has also been proposed as a possible risk factor for cancers of the lung and larynx. Asbestos exposure is another known risk factor for lung cancer. Liver cancer has been associated with numerous risk factors such as alcohol abuse, viral diseases, dietary intake, hereditary factors, and chemical exposures. Kidney/renal cancers have been best associated with obesity, radiation exposure, tobacco use, chemotherapy for other cancers, and family history; less clear associations include alcohol use, dietary factors, exposure to heavy metals, and occupational exposure to asbestos and a variety of volatile chemicals. Hormonal and family history factors are known to influence endometrial cancer, but nutritional factors have also been implicated as possible causes.

Considering that our investigation of community concerns about health around SeaTac Airport is ongoing, final conclusions would be premature. Investigation of historical data before 1992 requires continued efforts, and follow-up of community case reports is still in progress. Following completion of tasks outlined in Phase 1 of the work plan, the feasibility and desirability of further investigation will be more appropriately evaluated.

BACKGROUND

In response to community concerns about health around SeaTac International Airport, Senator Julia Patterson arranged two meetings in 1998 with community residents, the Washington State Department of Health (DOH), Seattle-King County Department of Public Health (SKCDPH) and other interested parties. Those meetings and preliminary DOH findings of elevated glioblastoma for 1992 through 1995 in an area roughly 3 miles around the airport led to Senator Patterson's request that DOH work with SKCDPH and the community to develop a work plan to address the community's concerns.

Community representatives presented a list of 18 questions they wanted addressed in the work plan. The August 1998 work plan was divided into two phases. Answers to questions from Phase 1 activities were necessary to determine the value and feasibility of Phase 2 activities. Phase 1 activities included 10 questions. This report focuses on the first two questions in the work plan.

Question 1 of Phase 1 addressed concerns about which cancers are most prevalent around SeaTac Airport and known risk factors that may contribute to their being elevated. Question 2 asked whether rates of breast cancer are elevated in the proximity of the airport.

METHODS

We looked at data from the Washington State Cancer Registry to assess whether rates of cancer around SeaTac International Airport were higher than expected. In order to assure analytic precision, we first defined the SeaTac area using geospatial coding of both cancer and census data. After geocoding available data, we designated three areas around the airport for analysis: Area 1 is within 1 mile of the airport, Area 2 is within 3 miles, and Area 3 is within 5 miles.

We compared the number of cases for more than 25 cancer categories diagnosed from 1992 through 1996 in the areas around SeaTac Airport to the number of expected cases if the rates around the airport were the same as rates from two comparison groups. We used Washington State as one comparison group in calculating expected cases within the three areas around the airport. However, the population used for comparison in an epidemiologic study should be similar to the population under investigation, and using Washington State for comparison combines various types of populations. Since the area around SeaTac Airport is urban, we also used King County as a more comparable, predominantly urban comparison group.

The expected number of cases is the number of cases expected in the SeaTac Airport area if the rate around the airport is the same as the rate in King County or Washington State. To calculate the expected number of cases, we multiplied the population in a specific age range and sex category in the SeaTac Airport area by the rate of glioblastoma for the same age range and sex category in King County or Washington State. (Since the area around the airport is part of King County and comprises more than 10% of its population, we subtracted the SeaTac area of interest from both numerator and denominator in calculations of expected cases when using King County as the comparison group.) We then added the results for all the age and sex categories together and rounded to the nearest whole number to get a total number of expected cases.

Confidence intervals are used to assess variation in a rate related to random factors. We calculated 95%

Poisson confidence intervals around the observed number of cases to assess random variation. If the confidence interval did not include the expected number of cases, we concluded that the observed number was statistically different from the expected. If the expected number of cases was less than the lower limit of the interval, we concluded that the number of observed cases was higher than expected. If the expected number of cases was greater than the upper limit of the interval, we concluded that the number of observed cases was lower than expected.

Although inclusion of case reports from concerned citizens and buyout area residents were part of questions 3 and 4 of the work plan, we have made some progress on these questions. As a result, one case of glioblastoma diagnosed in 1993 after the person moved from the buyout area was included in our analyses as a resident of Area 1. Since this individual had originally been included in records for King County outside any of the three SeaTac zones, we also subtracted this person from the King County comparison group. Many other reports received for 1992 through 1996 were already appropriately included in our existing databases.

RESULTS

The results of our analyses are presented in Table 1 on page 7 of this report. The ten most common types of cancer around SeaTac Airport were breast, lung, prostate, colorectal, melanoma, non-Hodgkin's lymphoma, bladder, endometrium, oral/pharynx, and kidney/renal; these are also the ten most common types of cancer in both King County and Washington State as a whole.

Of the cancer categories assessed, results varied according to the designated distance from SeaTac Airport. For Area 1, we found that the number of observed cases was higher than expected for cancers of the endometrium and of the lung when compared to both King County and Washington State; oral/pharyngeal cancer was higher than expected only in comparison to Washington State. For Area 2, glioblastoma was higher than expected when compared to both King County and Washington State, laryngeal cancer was higher than expected when compared to King County, and liver cancer was elevated when compared to Washington State. Prostate cancer was lower than expected in Area 2 when compared to Washington State. For Area 3, laryngeal cancer was elevated when compared to both King County and Washington State; kidney/renal cancer was elevated when compared to King County; liver cancer was elevated when compared to Washington State. Also for Area 3, melanoma and prostate cancer were less than expected when compared to both King County and Washington State; all cancers, breast cancer and thyroid cancer were less than expected when compared to King County.

Brain cancers, particularly glioblastoma, were of specific interest to SeaTac-area residents. After including one glioblastoma case of a buyout area residence in our analyses, we found that observed cases of glioblastoma were slightly higher than expected in Area 2 when data from 1992 through 1996 were combined. Of the 28 people with glioblastoma in Area 2 during this period, 10 (36%) were diagnosed in 1992. The other years had between 3 and 6 people diagnosed each year, all of which were within expected range for the year (Page 8, Figure 1).

All leukemia and the subcategory of acute myeloid leukemia were also mentioned as specific concerns to SeaTac community representatives, but we found no elevation in either of these categories. Question 2 of the work plan specified interest in evaluating rates of breast cancer around SeaTac International Airport, but we found that observed cases of breast cancer were consistently within or less than the expected range.

DISCUSSION

Perhaps the most important consideration in assessing the results of these analyses involves the issue of random chance when doing statistical tests and the problem of increasing chance results when doing multiple comparisons. We used the usual scientific standard in which there is a 5% probability that a statistically significant result is by chance alone. In other words, there is a 5% chance that a statistically significant result does not represent a true difference from the expected result for each individual analysis. The probability of statistically significant results being due to chance alone increases proportionately with the number of individual tests of significance. By conducting our analyses using more than 25 cancer categories, we expect random variation of statistically significant results, some of which will be greater than expected and some of which will be lower than expected. A mixture of statistically significant results in both directions is demonstrated in Table 1. Some of these may represent true variations, but some are probably due to chance. Since we cannot determine from statistical tests alone which results are true and which are due to chance, other considerations must also influence our conclusions. In particular, consistency with prior studies and biologic plausibility are primary factors in interpreting results.

In May 1998, DOH did a preliminary analysis of State cancer data for the years 1992 through 1995 using zipcodes to roughly estimate the population around SeaTac Airport. That analysis focused on all cancer, all leukemia, and brain tumors (including gliomas and glioblastomas). The results suggested that the number of cases of all cancer and of glioblastoma were higher than expected, particularly in the area approximately 3 miles around the airport. Using more precise methods to define the areas around SeaTac Airport and adding another year of data to the analysis, we did not find an elevation of all cancer in any of the three areas evaluated. Although results of our latest analyses were not identical to the preliminary analyses, we did find elevated glioblastoma in the area within 3 miles of the airport. Our results were also consistent with the preliminary analyses in that the numbers of people diagnosed with glioblastoma were only elevated in 1992 and the numbers for the years 1993 through 1996 were not elevated.

The term cancer is nonspecific and refers to a variety of different diseases, most of which involve more than one risk factor. To identify risk factors associated with the types of cancer that were elevated in areas around SeaTac airport, we used the textbook edited by Schottenfeld and Fraumeni[1], a comprehensive review of the scientific literature related to causes of cancer through about 1995. No definitive causes of the increased numbers that could be specifically attributed to proximity to the airport were found. In responding to Question 7 of the August 1998 work plan, SKCDPH and DOH did an extensive review of the literature regarding environmental causes of glioblastoma. The consensus among researchers at this time is that causal factors for glioblastoma in people have not yet been identified. (Please refer to the summary of the literature review being issued in conjunction with this report and also dated February 25, 1999.)

Tobacco exposure is a well-established risk factor for cancers of the larynx, lung and oral/pharynx. Asbestos exposure is another known risk factor for lung cancer, and the combination of tobacco use with asbestos exposure substantially increases the risk of lung cancer. Alcohol abuse, particularly in combination with tobacco use, tends to increase the risk of laryngeal, oral and pharyngeal cancers. Air pollution has been proposed as a possible risk factor for cancers of the lung and larynx, but analytic studies to date have been inconclusive regarding the strength of this association.

[1] *Cancer Epidemiology and Prevention*, Schottenfeld D and Fraumeni JF (eds.), Oxford University Press, New York, 1996.

Liver cancer has been associated with numerous risk factors. Among the most prominent risk factors for liver cancer are alcohol abuse, viral diseases, dietary intake, hereditary factors, and chemical exposures.

Kidney/renal cancers have been best associated with obesity, radiation exposure, tobacco use, chemotherapy for other cancers, and family history; less clear associations include alcohol use, dietary factors, exposure to heavy metals, and occupational exposure to asbestos as well as a variety of volatile chemicals. Hormonal and family history factors are known to influence endometrial cancer, but nutritional factors have also been implicated as possible causes.

The DOH analyses for questions 1 and 2 of the work plan looked at ***new cases of cancer (incidence)*** around the airport. In contrast, the health assessment by SKCDPH for question 10 looked at ***death due to cancer (mortality)***. An ***incidence rate*** reflects the occurrence of the disease being studied. A ***mortality rate*** reflects deaths due to the disease. The term cancer includes a variety of diseases characterized by uncontrolled growth and spread of abnormal cells. In general, the most common types of cancer are not as fatal as less common types. While DOH found that the occurrence of all cancers in the area within 5 miles of the airport was less than expected in comparison to King County, the SKCDPH health assessment found an increase in cancer deaths around SeaTac Airport. We offer some possible explanations for this pattern:

- Although all types of cancer occurred slightly less often in the SeaTac area, those that occurred were more likely to result in death. Factors that can affect whether a cancer leads to death include the type of cancer, the person's access to and use of health care, and other health conditions. Of particular interest regarding the results from these two evaluations, lung cancer occurred more often and was also the leading cause of cancer deaths in the area around the airport.
- The increase in cancer mortality may reflect an earlier increase in cancer incidence. There is generally some period of time between diagnosis and death, so increased cancer deaths for 1993 through 1997, as found in the Seattle-King County health assessment, may indicate an increase in the occurrence of cancer before 1993. We are obtaining earlier and later years of data to further examine these questions.
- When all cancers for the five-year period from 1992 through 1996 are combined, the numbers become quite large (i.e., more than 5,300 cancer cases and over 1,000 cancer deaths were analyzed). Just as small numbers make finding small differences problematic in statistical analyses, analysis of large numbers often allows small differences to be statistically significant. A statistically significant difference is not always meaningful from a clinical or public health perspective. For instance, the rate of cancer *cases* was only 4% less than expected using King County as the comparison group; the rate of cancer *deaths* was only 9% higher than the County.

Considering that the investigation of community concerns about health in the proximity of SeaTac International Airport is ongoing, final conclusions would be premature. (Please refer to the work plan progress report being issued in conjunction with this report and also dated February 25, 1999.) Investigation of historical data before 1992 requires continued efforts, and follow-up of community case reports is still in progress. Answers to some of the remaining questions may help us interpret these findings better.